CLAIMS

What is claimed is:

1. A high density multi-layer microcoil comprising:

a substrate;

a multi-layer coil winding, formed on said substrate, composed of a plurality of coil element layers linking one another; two ends of said coil layers are contact points for outer circuits; and

a dry film photoresist structure, formed on said substrate and enclosing said multi-layer coil winding for supporting said coil winding.

2. A high density multi-layer microcoil according to claim 1 further comprises a magnetic core formed in an axis of said coil winding and parallel to said substrate.

3. A high density multi-layer microcoil according to claim 2 wherein said magnetic core is made of a material of high magnetic permeability.

4. A high density multi-layer microcoil according to claim 3 wherein said high magnetic permeability material is chosen from supermalloy, which is composed of 79% nickel, 15% iron, 5% molybdenum and 0.5% manganese; high magnetic permeability alloy (78.5% nickel and 21.5% iron); iron and cobalt alloy, pure (99.96%) iron and silicon steel.

5. A high density multi-layer microcoil according to claim 1 wherein said dry film photoresist is chosen from negative photoresist materials.

6. A high density multi-layer microcoil according to claim 1 wherein said dry film photoresist is SU-8.

7. A high density multi-layer microcoil according to claim 1 wherein said dry film

photoresist is chosen from high strength materials.

8. A high density multi-layer microcoil according to claim 1 wherein said coil winding is made of conductive materials with low melting point.

9. A high density multi-layer microcoil according to claim 1 wherein said coil winding is made of lead and tin alloys.

10. A high density multi-layer microcoil according to claim 1 wherein each coil element comprises at least two windings.

11. A process for fabricating a high density multi-layer microcoil comprising steps of:

providing a substrate;

using photolithography process to form a dry film photoresist structure with a coil tunnel having coil elements perpendicular to said substrate and two outlets at ends of said tunnel; and

injecting a conductive material with low melting point into said tunnel and forming a coil winding.

12. A process for fabricating a high density multi-layer microcoil according to claim 11 wherein said steps of forming said photoresist structure depend on number of windings in each coil element; for a coil element with N windings, said windings are numbered as 1 to N from inner to outer; each coil winding is composed of a top parallel portion, a bottom parallel portion and two vertical portions and formed as a planar coil element perpendicular to said substrate; said photoresist structure is made by 4N+1 times of deposition, comprising steps of:

depositing first to 2Nth photoresist materials, using photolithography to form said lower half portions of said 1 to N windings of said coil elements; said lower haft portions comprises bottom parallel portions and lower halves of vertical portions;

depositing 2N+1 to 4Nth photoresist materials, using photolithography process to form said upper half portions of said N to 1 windings of said coil elements; said upper haft portions comprises upper halves of vertical portions and top parallel portions; and

depositing last (4N+1) photoresist material, using photolithography to form a top of said photoresist structure.

13. A process for fabricating a high density multi-layer microcoil according to claim 12 wherein said dry film photoresist is chosen from high strength materials.

14. A process for fabricating a high density multi-layer microcoil according to claim 11 wherein said coil winding is made of conductive materials with low melting point.

15. A process for fabricating a high density multi-layer microcoil comprising steps of:

providing a substrate;

using photolithography process to form a dry film photoresist structure for a lower half coil tunnel;

depositing an insulation layer on top of said lower half coil tunnel;

using photolithography process to form a magnetic core on said insulation layer and in center portion of said photoresist structure;

removing said insulation layer;

using photolithography process to form a dry film photoresist structure for an upper half coil tunnel, which covers said magnetic core, and forms a coil tunnel having coil elements perpendicular to said substrate and two outlets at ends of said tunnel; and

injecting a conductive material with low melting point into said tunnel and forming a coil winding.

16. A process for fabricating a high density multi-layer microcoil according to claim 15

wherein said steps of forming said photoresist structure of lower and upper half coil tunnels depend on number of windings in each coil element; for a coil element with N windings, said windings are numbered as 1 to N from inner to outer; each coil winding is composed of a top parallel portion, a bottom parallel portion and two vertical portions and formed as a planar coil element perpendicular to said substrate; said photoresist structure is made by 4N+1 times of deposition, comprising steps of:

depositing first to 2Nth photoresist materials, using photolithography to form said lower half portions of said 1 to N windings of said coil elements; said lower haft portions comprises bottom parallel portions and lower halves of vertical portions;

depositing 2N+1 to 4Nth photoresist materials, using photolithography process to form said upper half portions of said N to 1 windings of said coil elements; said upper haft portions comprises upper halves of vertical portions and top parallel portions; and

depositing last (4N+1) photoresist material, using photolithography to form a top of said photoresist structure.

17. A process for fabricating a high density multi-layer microcoil according to claim 16 wherein said dry film photoresist is chosen from high strength materials.

18. A process for fabricating a high density multi-layer microcoil according to claim 15 wherein said coil winding is made of conductive materials with low melting point.

19. A process for fabricating a high density multi-layer microcoil according to claim 15 wherein said magnetic core is made of high magnetic permeability materials.

20. A process for fabricating a high density multi-layer microcoil according to claim 15 wherein said magnetic core is made of materials chosen from silicon dioxide and silicon nitride.